

~~126~~  
198.

A method of invoking a service at a first machine, comprising the steps of:  
receiving at said first machine a service invocation request generated at a second machine in compliance with a markup language-based message encoding, wherein said message includes plural elements and wherein all elements in said message have element type names selected from an encoding group having a predetermined number of members, with at least two of said members (e.g., RECORD and ARRAY) designating elements containing other elements having element type names belonging to said group; and  
invoking said service in response to said request.

~~127~~  
199.

A method of invoking a service at a first machine from a second machine, comprising the steps of:

*Cont*  
generating a service invocation request message at said second machine in compliance with a markup language-based message encoding, wherein said message includes plural elements and wherein all elements in said message have element type names selected from an encoding group having a predetermined number of element type names, including at least a first (e.g., VALUE) element type name for designating an element containing data, and a second (e.g., RECORD) element type name for designating an element containing a set of children elements having element type names selected from said group; and  
transmitting said message.

~~128~~  
200.

A method of invoking a service at a first machine, comprising the steps of:  
receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding, wherein said message includes plural elements and wherein all elements in said message have element type names selected from an encoding group having a predetermined number of element type names, including at least a first (e.g., VALUE) element type name for designating an element containing data, and a second (e.g., RECORD) element

type name for designating an element containing a set of children elements having element type names selected from said group; and

invoking said service in response to said message.

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201. A method of invoking a service at a first machine, said method comprising the steps of:

receiving at said first machine a service invocation request;

invoking said service in response to said request; and

transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding, wherein said message includes plural elements and wherein all elements in said message have element type names selected from an encoding group having a predetermined number of element type names, including at least a first (e.g., VALUE) element type name for designating an element containing data, and a second (e.g., RECORD) element type name for designating an element containing a set of children elements having element type names selected from said group.

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202. A method of invoking a service at a first machine, said method comprising the steps of:

transmitting a service invocation request from a second machine; and

receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding, wherein said message includes plural elements and wherein all elements in said message have element type names selected from an encoding group having a predetermined number of element type names, including at least a first (e.g., VALUE) element type name for designating an element containing data, and a second (e.g., RECORD) element type name for designating an element containing a set of children elements having element type names selected from said group.

<sup>131</sup>  
~~203.~~ A method according to claim any one of claims <sup>127-130</sup>~~199-202~~, wherein said encoding group further includes a third element type name (e.g., LIST or ARRAY) for designating an element containing a set of elements having element type names selected from said group.

<sup>132</sup>  
~~204.~~ A method according to claim <sup>131</sup>~~203~~, wherein said encoding group includes a fourth element type name (e.g., ARRAY or LIST) for designating an element containing a set of elements having element type names selected from said group.

<sup>133</sup>  
~~205.~~ A method according to claim <sup>131</sup>~~203~~, wherein said encoding group includes a fourth element type name (e.g., OBJECT) for designating an element uniquely identifying another encoding element within a particular message.

*Cont* <sup>134</sup>  
~~206.~~ A method according to claim <sup>131</sup>~~203~~, wherein said encoding group includes a fourth element type name (e.g., NULL) for designating the absence of a data item.

<sup>135</sup>  
~~207.~~ A method according to claim <sup>133</sup>~~205~~, wherein said encoding group includes a fifth element type name (e.g., NULL) for designating the absence of a data item.

<sup>136</sup>  
~~208.~~ A method according to claim <sup>135</sup>~~207~~, wherein said encoding group includes a sixth element type name (e.g., ARRAY or LIST) for designating an element containing a set of elements having element type names selected from said group.

<sup>137</sup>  
~~209.~~ A method according to claim <sup>131</sup>~~203~~, wherein said third element type name (e.g., ARRAY) designates an element containing an n-dimensional array (where n is an integer such that  $n \geq 1$ ) of elements having element type names selected from said encoding group.

<sup>138</sup>  
~~210.~~ A method according to any one of claims <sup>127-130</sup>~~199-202~~, wherein said encoding provides a type label associated with an element having said first element type name.

~~139~~  
~~211.~~ A method according to claim ~~210~~<sup>138</sup>, wherein an element of said first element type name with no type label is assumed to be a string type element.

~~140~~  
~~212.~~ A method according to claim ~~210~~<sup>138</sup>, wherein said type label is expressed as an XML attribute on said element having said first element type name, with the data type of a data item contained in said element is designated by the value of said attribute.

~~141~~  
~~213.~~ A method according to claim ~~203~~<sup>131</sup>, wherein said encoding group further includes a fourth element type name (e.g., NUMBER) for designating an element representing a numeric value.

*C/cont*  
~~142~~  
~~214.~~ A method according to claim ~~203~~<sup>131</sup>, wherein said encoding group includes multiple type names each designating a respective different type of data item contained in an element having said first type name.

~~143~~  
~~215.~~ A method according to claim ~~203~~<sup>131</sup>, wherein said message further includes a semantic label for at least one data item contained in said message.

~~144~~  
~~216.~~ A method according to claim ~~215~~<sup>143</sup>, wherein said semantic label is represented by the value of an XML attribute on the element containing said data item.

~~145~~  
~~217.~~ A method of invoking a service at a first machine from a second machine, said method comprising the steps of:

generating a service invocation request message at said second machine in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said message including at least one data item which is a multi-level

nested array element where each nesting level corresponds to a respective dimension of said array element; and

transmitting said service invocation request message from said second machine.

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218. A method of invoking a service at a first machine, comprising the steps of:

receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said message including at least one data item which is a multi-level nested array element where each nesting level corresponds to a respective dimension of said array element; and

invoking said service in response to said message.

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219. A method of invoking a service at a first machine, said method comprising the steps of:

receiving at said first machine a service invocation request;

invoking said service in response to said request; and

transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said message including at least one data item which is a multi-level nested array element where each nesting level corresponds to a respective dimension of said array element; and

transmitting said service invocation reply message from said second machine.

~~148~~  
~~220.~~ A method of invoking a service at a first machine, said method comprising the steps of:

transmitting a service invocation request from a second machine; and

receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said message including at least one data item which is a multi-level nested array element where each nesting level corresponds to a respective dimension of said array element.

*Cont*  
~~149~~  
~~221.~~ A method of invoking a service at a first machine from a second machine, said method comprising the steps of:

generating a service invocation request message at said second machine in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said request message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said label indicating a value of n but not indicating a size for each of said n dimensions; and

transmitting said service invocation request message from said second machine.

~~150~~  
~~222.~~ A method of invoking a service at a first machine, comprising the steps of:  
receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of

names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said request message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said label indicating a value of n but not indicating a size for each of said n dimensions; and

invoking said service in response to said message.

<sup>151</sup>  
~~223.~~ A method of invoking a service at a first machine, said method comprising the steps of:

receiving at said first machine a service invocation request;

invoking said service in response to said request; and

*C. Cont*  
transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said reply message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said label indicating a value of n but not indicating a size for each of said n dimensions; and

transmitting said service invocation reply message from said second machine.

<sup>152</sup>  
~~224.~~ A method of invoking a service at a first machine, said method comprising the steps of:

transmitting a service invocation request from a second machine; and

receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said

group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said reply message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said label indicating a value of n but not indicating a size for each of said n dimensions.

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225. A method of invoking a service at a first machine from a second machine, said method comprising the steps of:

generating a service invocation request message at said second machine in compliance with a mark-up language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said request message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said encoding requiring that all data items contained within said array as direct children have the same type as one another; and

transmitting said service invocation request message from said second machine.

154

226. A method of invoking a service at a first machine, comprising the steps of:

receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said request message including at least one data item which is an array of dimension n and a label associated with said data item and



designating said data item as having an array type, said encoding requiring that all data items contained within said array as direct children have the same type as one another; and

invoking said service in response to said message.

<sup>155</sup>  
~~227.~~ A method of invoking a service at a first machine, said method comprising the steps of:

receiving at said first machine a service invocation request;

invoking said service in response to said request; and

transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said reply message including at least one data item which is an array of dimension n and a label associated with said data item and designating said data item as having an array type, said encoding requiring that all data items contained within said array as direct children have the same type as one another; and

transmitting said service invocation reply message from said second machine.

<sup>156</sup>  
~~228.~~ A method of invoking a service at a first machine, said method comprising the steps of:

transmitting a service invocation request from a second machine; and

receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding wherein each element in said message is associated with a type indicator selected from a group of names, said group of names including at least an array type name indicating that the corresponding element is an n-dimensional array containing a plurality of data items, where n is an integer and  $n \geq 1$ , said reply message including at least one data item which is an array of

dimension n and a label associated with said data item and designating said data item as having an array type, said encoding requiring that all data items contained within said array as direct children have the same type as one another.

<sup>157</sup>  
~~229~~. A method according to any one of claims <sup>153 156</sup>~~225-228~~, wherein said label identifies said same type.

<sup>158</sup>  
~~230~~. A method according to any one of claims <sup>149 156</sup>~~221-228~~, wherein said label is expressed as an XML attribute of said element such that the dimension n is given by the value of the attribute

<sup>159</sup>  
~~231~~. A method according to any one of claims <sup>149 156</sup>~~221-228~~, wherein said message is an XML document.

*C1 Cont*  
<sup>160</sup>  
~~232~~. A method according to any one of claims <sup>145 148</sup>~~217-220~~, wherein said message includes a label associated with said data item and designating said data item as having an array type.

<sup>161</sup>  
~~233~~. A method according to claim <sup>160</sup>~~232~~, wherein each of said second array elements includes at least one data item, with all data items in each of said second array elements being of the same type as one another.

<sup>162</sup>  
~~234~~. A method according to claim <sup>161</sup>~~233~~, wherein said label indicates the type associated with all data items contained in said array.

<sup>163</sup>  
~~235~~. A method according to any one of claims <sup>149 156</sup>~~221-228~~, wherein said label indicates a value of n but does not indicate a size for each of said n dimensions.

<sup>164</sup>  
~~236~~. A method according to any one of claims <sup>145 148</sup>~~217-220~~, wherein said message includes a label associated with said data item and designating said data item as having an array type, said

encoding requiring that all data items contained within said array as direct children have the same type as one another.

<sup>165</sup>  
~~237.~~ A method of invoking a service at a first machine from a second machine, said method comprising the steps of:

generating a service invocation request message at said second machine in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names including at least first and second element type names (e.g., RECORD and OBJECT), wherein said message associates an element of said first type name with an ID value, and wherein said message includes an element of said second type name (OBJECT) which specifies said ID value; and

transmitting said service invocation request message from said second machine.

*Cont*  
<sup>166</sup>  
~~238.~~ A method of invoking a service at a first machine, comprising the steps of:

receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names including at least first and second element type names (e.g., RECORD and OBJECT), wherein said message associates an element of said first type name with an ID value, and wherein said message includes an element of said second type name (OBJECT) which specifies said ID value; and  
invoking said service in response to said message.

<sup>167</sup>  
~~239.~~ A method of invoking a service at a first machine, said method comprising the steps of:

receiving at said first machine a service invocation request;  
invoking said service in response to said request; and

transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names including at least first and second element type names (e.g., RECORD and OBJECT), wherein said message associates an element of said first type name with an ID value, and wherein said message includes an element of said second type name (OBJECT) which specifies said ID value; and

transmitting said service invocation reply message from said second machine.

168  
240.  
steps of:

A method of invoking a service at a first machine, said method comprising the

transmitting a service invocation request from a second machine; and

receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names including at least first and second element type names (e.g., RECORD and OBJECT), wherein said message associates an element of said first type name with an ID value, and wherein said message includes an element of said second type name (OBJECT) which specifies said ID value.

169  
241.  
method comprising the steps of:

generating a service invocation request message at said second machine in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names, said group of names including at least one placeholder element type name (e.g., NULL or OBJECT) that designates a placeholder element which represents the absence of data; and

transmitting said service invocation request message from said second machine.

170  
242.

A method of invoking a service at a first machine, comprising the steps of:  
receiving at said first machine a service invocation request message generated at a second machine in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names, said group of names including at least one placeholder element type name (e.g., NULL or OBJECT) that designates a placeholder element which represents the absence of data; and  
invoking said service in response to said message.

171  
243.

Cont  
steps of:

A method of invoking a service at a first machine, said method comprising the  
receiving at said first machine a service invocation request;  
invoking said service in response to said request; and  
transmitting from said first machine a service invocation reply message in compliance with a markup language-based message encoding, wherein each element in said message is associated with an element type name selected from a group of names, said group of names including at least one placeholder element type name (e.g., NULL or OBJECT) that designates a placeholder element which represents the absence of data; and  
transmitting said service invocation reply message from said second machine.

172  
244.

steps of:

A method of invoking a service at a first machine, said method comprising the  
transmitting a service invocation request from a second machine; and  
receiving at said second machine a service invocation reply message in compliance with a markup language-based message encoding, wherein , wherein each element in said message is associated with an element type name selected from a group of names, said group of names including at least one placeholder element type name (e.g.,

NULL or OBJECT) that designates a placeholder element which represents the absence of data.

<sup>173</sup>  
~~245~~. A method according to any one of claims <sup>169 172</sup>~~241-244~~, wherein said placeholder element (e.g., NULL) represents a programming language null object reference.

<sup>174</sup>  
~~246~~. A method according to any one of claims <sup>169 172</sup>~~241-244~~, wherein said placeholder element (e.g., OBJECT) identifies a data item contained elsewhere in said message.

<sup>175</sup>  
~~247~~. A method according to any one of claims <sup>165 168</sup>~~237-240~~, wherein said message includes a type label associated with said placeholder element.

<sup>176</sup>  
~~248~~. A method according to any one of claims <sup>165 168</sup>~~237-240~~, wherein said message includes a semantic label associated with said placeholder element.

<sup>177</sup>  
~~249~~. A method according to claim <sup>175</sup>~~247~~, wherein said message includes a semantic label associated with said placeholder element.

<sup>178</sup>  
~~250~~. A method according to any one of claims <sup>165 168</sup>~~237-240~~, wherein said encoding permits any data item in a message to be associated with an ID which uniquely identifies said data item within said message.

<sup>179</sup>  
~~251~~. A method according to claim <sup>178</sup>~~250~~, wherein said ID is associated with a data item via an XML attribute on said data item whose value is said ID.